

Claims:

1. A receiver responsive to an n_o plurality of entry points comprising:
a feedforward filter structure having an $n_o \times n_i$ plurality of FIR filters, each
responsive to a signal that is derived from one of said n_o entry points and each
developing an output signal that contributes to one of n_i feedforward filter structure
outputs;

a feedback filter structure developing n_i feedback signals, the structure
having an $n_i \times n_i$ plurality of FIR filters, each being responsive to one of n_i output
signals;

a subtractor structure that develops n_i signals from signals of said n_i
feedforward filter structure outputs and said n_i feedback signals; and

decision logic responsive to said n_i outputs developed by said subtractor
structure, for developing said n_i output signals.

2. The receiver of claim 1 further comprising a sampling circuit interposed
between said n_o plurality of entry points and said feedforward filter structure that
samples received signal at rate $T_s = \frac{T}{l}$, where l is an integer and T is symbol rate
of a transmitter whose signals said receiver receives.

3. The receiver of claim 2 where $l > 1$.

4. The receiver of claim 1 where further including a processor coupled to
signals applied to said feedforward filter structure, for computing coefficients of
said FIR filters included in said feedforward filter structure and of said FIR filters
included in said feedback filter structure.

5. The receiver of claim 4 where coefficients are computed in said
processor in response to a block of N_f symbols.

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6. The receiver of claim 4 where said coefficients are computed in a non-iterative manner.

7. The receiver of claim 4 where said coefficients are computed with a non-iterative equation.

8. The receiver of claim 4 where said coefficients are computed once every time interval that is related to rapidity of change in characteristics of transmission medium preceding said entry points.

9. The receiver of claim 8 where said processor installs computed coefficients of said FIR filters in said FIR filters following each computation.

10. The receiver of claim 1 where said FIR filters in said feedforward filter structure form an array of filters that includes one FIR filter connected between each of said n_o input points and said n_i outputs.

11. The receiver of claim 10 where said entry points are antennas and said n_o plurality of antennas receive signals, via a transmission channel, from a transmitter having a multiple number of transmitting antennas.

12. The receiver of claim 11 where said transmitter has n_i transmitting antennas.

13. The receiver of claim 2 where said plurality of FIR filters in said feedforward structure is expressed by matrix W , and W is computed by $W_{opt}^* = \tilde{B}_{opt}^* R_{xy} R_{yy}^{-1}$, $W_{opt}^* = \tilde{B}_{opt}^* R_{xx} H^* (H R_{xx} H^* + R_{nn})^{-1}$, or $W_{opt}^* = \tilde{B}_{opt}^* (R_{xx}^{-1} + H^* R_{nn}^{-1} H)^{-1} H^* R_{nn}^{-1}$, where R_{xx} is an autocorrelation matrix of a block of signals transmitted by a plurality of transmitting antennas to said n_o antennas via a channel having a transfer characteristic H , R_{nn} is an autocorrelation matrix of

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noise received by said plurality of n_o antennas during said block of signals transmitted by said transmitting antennas, $\mathbf{R}_{xy} = \mathbf{R}_{xx}\mathbf{H}^*$, $\mathbf{R}_{yy} = \mathbf{H}\mathbf{R}_{xx}\mathbf{H}^* + \mathbf{R}_{nn}$, and $\tilde{\mathbf{B}}_{opt}^*$ is a sub-matrix of matrix \mathbf{B}_{opt}^* , where $\mathbf{B}_{opt} = \text{argmin}_{\mathbf{B}} \text{trace}(\mathbf{R}_{ee})$ subject to a selected constraint, \mathbf{R}_{ee} being the error autocorrelation function.

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14. The receiver of claim 13 where said plurality of FIR filters in said feedback structure is expressed by matrix $\begin{bmatrix} \mathbf{I}_{n_i} & \mathbf{0}_{n_i \times n_i N_b} \end{bmatrix} - \mathbf{B}^*$.

15. The receiver of claim 1 where coefficients of the FIR filters in said feedforward filter are set to results in an effective transmission channel \mathbf{B} with memory N_b , where $N_b \leq \nu$, where \mathbf{B} is optimized so that $\mathbf{B}_{opt} = \text{argmin}_{\mathbf{B}} \text{trace}(\mathbf{R}_{ee})$ subject to a selected constraint; \mathbf{R}_{ee} being the error autocorrelation function, the feedback filter is modeled by $\begin{bmatrix} \mathbf{I}_{n_i} & \mathbf{0}_{n_i \times n_i N_b} \end{bmatrix} - \mathbf{B}^*$, where n_i is the number of outputs in the feedforward filter, as well as the number of outputs in the feedback filter, and the feedforward filter is modeled by \mathbf{W} , where $\mathbf{W}_{opt}^* = \tilde{\mathbf{B}}_{opt}^* \mathbf{R}_{xy} \mathbf{R}_{yy}^{-1}$, \mathbf{R}_{xy} is the cross correlation between transmitted signals and signals received by said receiver, and \mathbf{R}_{yy} is the autocorrelation of the received signals.

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16. The receiver of claim 15 where said selected constraint is $\tilde{\mathbf{B}}^* \Phi = \mathbf{C}^*$,

20 where $\Phi \equiv \begin{bmatrix} \mathbf{I}_{n_i} & \mathbf{0} & \dots & \mathbf{0} \\ \mathbf{0} & \mathbf{I}_{n_i} & \vdots & \vdots \\ \vdots & \mathbf{0} & \ddots & \mathbf{I}_{n_i} \\ \mathbf{0} & \dots & \dots & \mathbf{0} \end{bmatrix}$ and $\mathbf{C}^* = \begin{bmatrix} \mathbf{0}_{n_i \times n_i \Delta} & \mathbf{I}_{n_i} \end{bmatrix}$.

17. The receiver of claim 15 where said selected constraint is $\tilde{\mathbf{B}}^* \Phi = \mathbf{C}^*$,

where $\Phi \equiv \begin{bmatrix} \mathbf{I}_{n_i} & \mathbf{0} & \dots & \mathbf{0} \\ \mathbf{0} & \mathbf{I}_{n_i} & \vdots & \vdots \\ \vdots & \mathbf{0} & \ddots & \mathbf{I}_{n_i} \\ \mathbf{0} & \dots & \dots & \mathbf{0} \end{bmatrix}$ and $\mathbf{C}^* = \begin{bmatrix} \mathbf{0}_{n_i \times n_i \Delta} & \mathbf{B}_0^* \end{bmatrix}$, \mathbf{B}_0^* being a monic lower-

triangular matrix whose entries are optimized to minimize $\text{trace}(\mathbf{R}_{ee,min})$

18. The receiver of claim 15 where said selected constraint is $\mathbf{e}_i^* \mathbf{B}_0 \mathbf{e}_i = 1$, where \mathbf{e}_i is a vector with value 1 in position i and values 0 elsewhere, and where \mathbf{B}_0^* being a monic lower-triangular matrix whose entries are optimized to minimize $\text{trace}(\mathbf{R}_{ee,min})$.

19. The receiver of claim 13 wherein said plurality of FIR filters in said feedback filter structure and in said feedforward filter structure are subjected to designer constraints relative to any one or a number of members of the following set: transmission channel memory, size of said block, effective memory of the combination consisting of said transmission channel; n_i , n_o , autocorrelation matrix \mathbf{R}_{xx} , autocorrelation matrix \mathbf{R}_{nn} , value of factor l in said sampling circuit, and decision delay.

20. The receiver where said matrix \mathbf{W} is expressible by

$\mathbf{W} \equiv [\mathbf{W}_0 \quad \mathbf{W}_1 \quad \dots \quad \mathbf{W}_{N_f-1}]^t$, where matrix \mathbf{W}_q is a matrix that specifies q^{th} tap

coefficients of said FIR filters.